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NOTES

ON THE

CHAPIN MINE,

IRON MOUNTAIN, MICH.,

OCTOBER, 1890.

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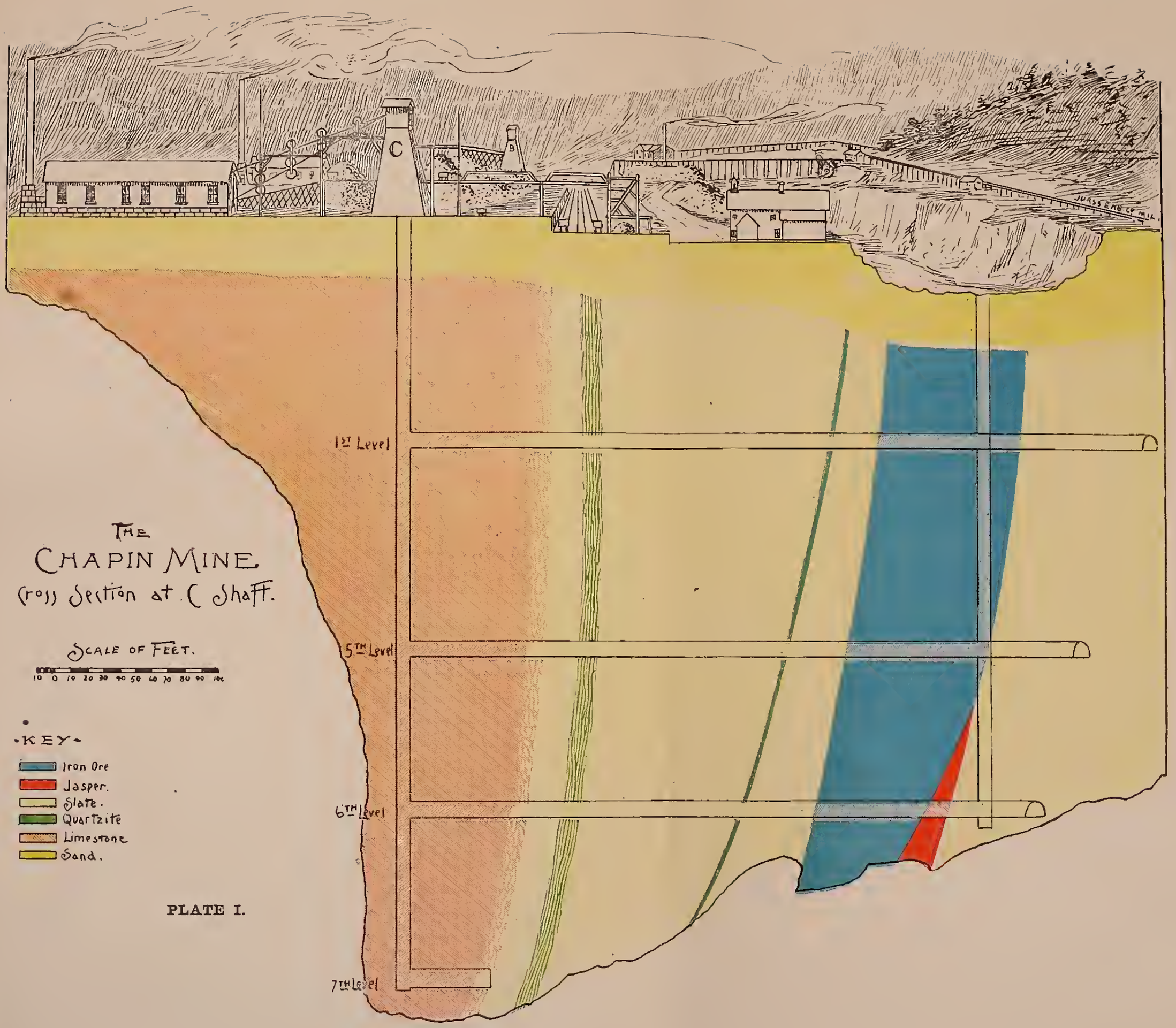
OCT 20 1890

BURDICK, ARMITAGE & ALLEN, PRINTERS, MILWAUKEE.



THE CHAPIN MINE.

Cross Section at C Shaft.

SCALE OF FEET.

10 0 10 20 30 40 50 60 70 80 90 100

KEY

- Iron Ore
- Jasper.
- Slate.
- Quartzite
- Limestone
- Sand.

PLATE I.

The following notes on the Chapin Mine were collected principally for the convenience of the engineers who intend to visit the mine this fall.

For detailed information on the geology and on the mines of Northern Michigan one must refer to the geological reports of Wisconsin and Michigan and to many excellent papers in the Transactions of the American Institute of Mining Engineers.

As only comparatively few can hear the remarks made by the guides when walking around a large mine, the undersigned hopes that the following notes will be of some service.

Mr. Ferdinand Schlesinger, President of the Chapin Mining Company, has kindly permitted the publication of these notes, and for much assistance in collecting them I wish to express my obligations to Mr. C. H. Cady, superintendent at the mine, and to his assistant, Mr. James McNaughton. Under Mr. Cady's superintendency the mine has attained its present large output of ore.

GEORGE W. GOETZ.

Milwaukee, Wis., October, 1890.

During the past thirty-four years the Lake Superior iron ore region has produced about 48,138,421 tons of iron ore, the different districts contributing to the production about as follows:

Marquette district - - - - -	29,754,057 tons
Menominee district - - - - -	10,416,859 tons
Gogebic district - - - - - -	5,622,194 tons
Vermillion district - - - - - -	2,342,991 tons
Miscellaneous - - - - - -	2,320 tons
	48,138,421 tons.

In the year 1889 the production of all the districts amounted to nearly 7,300,000 tons, the Menominee district contributing about 1,800,000 tons, of which 518,990 tons were raised out of the Chapin mine. Since the opening of the Chapin mine in 1878 nearly 3,000,000 tons of ore have been mined.

The production for 1890 will be largely increased in all the districts; the Chapin mine alone will increase its output to about 800,000 tons.

The production of the entire Lake Superior region will probably exceed 9,000,000 tons of ore for the season of 1890, the greatest portion of which will carry not less than 60 per cent. in iron.

This large amount of ore is shipped to the lake ports from either Escanaba, Marquette, Ashland, Two Harbors or Gladstone.

The large ore docks at these ports are worthy of a visit, as considerable thought and means have been spent in their construction.

At Cleveland, Ashtabula or at South Chicago the best unloading devices will be found for discharging ore vessels.

At the Escanaba docks steamers of recent construction were loaded as follows:

S. S. Cambria loaded 2,532 gross tons in eight hours.

S. S. Corsica loaded 2,696 gross tons in eight hours.

S. S. Corona loaded 2,600 gross tons in six hours.

At Ashtabula—

S. S. Corsicia unloaded 2,786 gross tons in nine hours and thirty-one minutes.

S. S. Carona unloaded 2,364 gross tons in seven hours and thirty minutes.

Distance from Escanaba to Cleveland is 550 miles.

Distance from Marquette to Cleveland is 609 miles.

Distance from Ashland to Cleveland is 798 miles.

Distance from Two Harbors to Cleveland is 819 miles.

The distance from Escanaba to Cleveland has been made in forty hours.

The dimension of the steel ships now in course of construction by the Globe Iron Works Company for the Menominee Transit Company are:

Length of keel,	296 feet.
Length over all,	316 feet.
Width of beam,	40 feet.
Depth,	24½ feet.

Engines—Triple Expansion—

High pressure cylinder,	24 inches.
Intermediate,	38 inches.
Low pressure,	61 inches.
Stroke,	42 inches.

Two boilers, 12′ 6″ long by 14′ diameter.

The cargoes which the steamers are capable of taking depend on the stage of the water. Taking this year as a basis, the steamers will be able to carry from 2675 to 2700 gross tons.

Plate II. will show the relative positions of the iron ore mining districts and the distances of the lake shipping ports to the receiving ports. The mining districts are reached conveniently by rail from Chicago. A one night's ride from Chicago will bring one to the mines in the morning, Pullman sleepers being at disposal. The distance of the Chapin mine from Chicago is 292 miles. Considerable ore is shipped to Chicago by rail, especially after the close of navigation in the latter part of November.

THE CHAPIN MINE.

The Menominee district is about twenty-seven miles long, north of the Menominee river, extending westward, and consists of three groups of the Huronian rocks. The supporting group consists of silicious limestone, the next group, containing the iron ore deposits, consists of silicious slates impregnated with iron oxide and argillaceous slates, the silicious slates being next to the limestone. The third group consists of grey slaty beds with quartzose bands called the Lake Hanbury slate group. The ridge is frequently capped by large horizontal layers of Potsdam sandstone, the latter furnishing the material for filling in the Chapin mine.

The Chapin mine is situated on the S. ½ of the S. W. ¼ and the S. W. ¼ of the S. E. ¼ of Sec. 30, T. 40, Range 30, Menominee district, Michigan.

Plate I shows a vertical section through the Chapin mine at "C" shaft, the principal hoisting shaft at the present time.

The main ore body lies between clay slates. The clay slates on the hanging side are about two hundred feet thick and are covered by magnesian limestone, whereas on the foot-wall the slates are somewhat more furruginous and are followed by alternate layers of slate and lean ore. Bands of quartzite and jasper also alternate with the slates.

Plate III is a horizontal projection, showing that the mine consists of four lenticular deposits, the main one being about 2500 feet long, has a strike of N. 75 degrees W., dips from 60 degrees to 89 degrees north and pitches west from 30 degrees to 45 degrees. In width it varies from three to four feet at the ends to 130 feet in the center. As to the depth of the ore, nothing is known; the eighth level is the lowest level at present and still shows a width of ore of 100′ between "C" and "D" shafts. The ore reserves in the main lense are therefore very large.

At the east end of the property are two lenses separated from the main deposit by about 30 feet of slates. The one farthest east is about 100 feet long and 20 feet wide, and the one nearer to the main deposit, the so-called North Vein, is about 150 feet long and up to 50 feet wide on the first level and on the seventh level it is about 500 feet long and 60 feet wide in the middle, which shows that this lense is also liable to show large ore reserves as the mine is developed in depth.

The fourth large lense at the west end, as shown on the map, extends upon the property of the Ludington Co. and is being worked by them by underground mining, but the part belonging to the Chapin Mining Co. is being stripped to work the deposit at first as an open mine. At a depth of

260′ at the boundry line of the two properties a face of clean ore about 70 feet wide is exposed.

The open pit is 300′ long by 160′ wide at the top. The average depth of the sand and gravel to the silicious capping was about 35 feet, its removal requiring the services of 74 teams for 48 days, of 10 hours each, excavating with the "Eclipse scoop."

The silicious capping is now being removed, so that before long a large body of clean ore will be at disposal.

This ore body has been worked to a depth of 1,200 feet on the adjoining property, and therefore the ore reserves in this deposit on the Chapin property are also large.

Plate IV. shows the workings in the main deposit.

The first work done at the Chapin was on the east end of the mine, and on account of the moderate width of the main deposit at this point it was mined by leaving pillars and timbering rooms with stulls. As the work progressed further west this system became impracticable, due to the increased width of the ore, and consequently another system had to be adopted. The shafts were still kept in the ore and rooms 20 feet wide were made, leaving pillars 18 feet wide, all the rooms being strongly timbered. When the mine attained a depth of from 300 to 500 feet the timbering proved inadequate to sustain the enormous pressure, resulting in several large caves, accompanied by the loss of some ore. The management then adopted the system of filling with rock. All the old rooms were filled with rock or with sand run through sand shafts from the surface, after which the pillars of ore were mined out.

The shafts were sunk in the hanging wall about 300 feet from the ore, cross-cuts were driven through the ore body and continued into the foot wall, from which the main levels were driven into the foot wall, parallel with the ore and from 60 to 100 feet distant from it.

From each of these levels at intervals of fifty feet, cross-cuts were made through the ore, and from each side of these cross-cuts small drifts from 20 to 30 feet long were made parallel with the ore body and beginning at the hanging wall. As soon as one drift or stope was completed it was filled with rock and then another one was started aside of it. These stopes were continued, side by side, until the foot-wall was reached, when it became necessary to drive a new cross-cut immediately above the filling just put in. The same work was then repeated until the next upper level was reached.

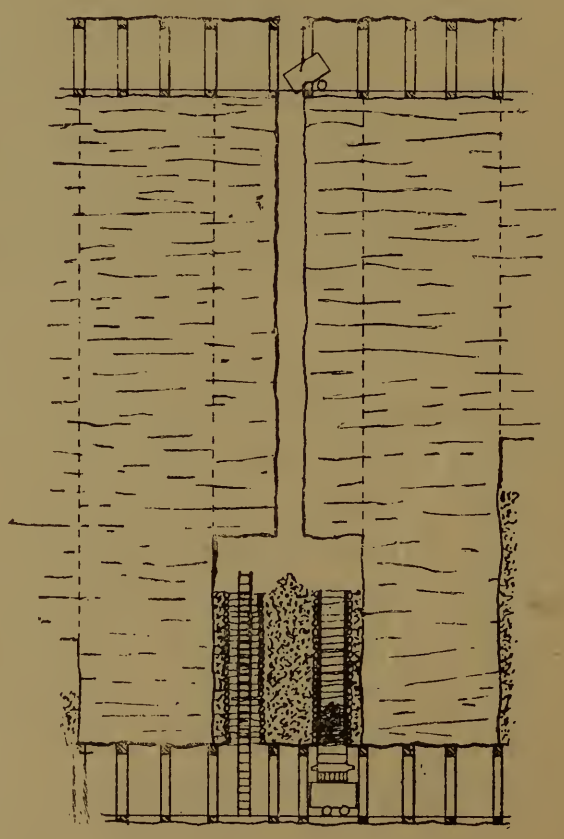
The rock filling, taken either from a sandstone quarry near the mine, or from the drifts and cross-cuts in the foot-wall, was taken in cars to the

level immediately above where it was to be used, and dumped down through winzes, from which it was easily taken through chutes and put in place. In this system, as the whole ore body is under-cut for almost its entire length, a gradual settling takes place, and therefore, in order to insure safety in mining, drift sets must be used in the stopes.

This method of mining is pursued above the sixth level of the mine. Below the sixth level, and in that part of the mine not under-cut by the old system, a new method has been adopted, which is a combination of the main features of the two last described methods.

The levels are driven in the center of the ore body and rooms twenty feet wide are opened, extending from foot to hanging wall, and between each two rooms an 18 foot pillar is left. Each room is connected with the level above it by a winze for bringing down the rock filling, and in each room two mills are cribbed in the filling, one for a ladder-way and the other to run down the ore to the level below.

The accompanying sketch shows this system clearly.



When a room is started its first floor is at the same elevation as the back of the level. A stope 9 feet high and 20 feet wide is cut across the lense, and when both hanging and foot walls are reached the mills are cribbed up and then the room is filled with rock from above. The rock filling, when in place, forms a floor for the next stope above.

When the rock filling becomes thoroughly packed in place the pillars can be mined out in the same manner. But very little timber is used as this system is only used in ground that is rigid and where no settling has taken place.

WIRE ROPE HAULAGE.

Wire rope haulage has been introduced on the seventh and eighth levels for "B" shaft and on the sixth level for "C" shaft where a ¾ inch steel rope 3020 feet long is driven by a pair of 12 x 36 Corliss engines. The levels have two tracks, one for empty and one for loaded cars, each containing about two tons of ore. The cars are switched alternately to the right and to the left by an automatic switch placed about forty feet in front of shaft.

The empty cars are taken off the cages from the side opposite to the side on which they were placed when loaded, pass one side of the shaft and are again attached to the wire rope haulage.

SHAFTS AND THEIR EQUIPMENTS.

"A" SHAFT.

"A" shaft is 485′ deep, 8′x 18′ inside of timbers, dips about 70° north and has three compartments, two for pumps and one for hoisting ore. About 200 tons per day are hoisted at this shaft by a one ton skip. The hoisting engine is an 18 x 42 Corliss. The pumping is done by Cornish pumps with 12″ and 17″ plnngers operated by a pair of 24 x 48 Corliss engines. The Cornish pumps have a capacity of 1300 gallons per minute. There are five boilers at disposal if the compressed air should give out—four 16′x 60″ and one 16′x 54′.

Shaft A was sunk to work out the pillars in the old workings of the mine, and as these pillars are now nearly all removed this shaft will soon be abandoned.

Out of shafts A and A′ some ore is raised which is much lower in phosphorus than the regular Chapin ore. An analysis of the same will be found below. This ore goes to the furnaces under the name of "Crescent."

"B" SHAFT.

"B" shaft has two compartments, is vertical, 9′x12′ inside of timbers, and is 630 feet deep to the eighth level. The shaft contains two balanced cages.

The hoisting is done by a pair of 30x60 Corliss Engines and conical drums, 14′6″x10′6″x5′.

The hoisting rope is 1⅜″ in diameter.

The water for the boilers and for other purposes on the surface is raised by a pump placed at the sixth level—430 feet deep. *This shaft produces about 450 tons daily.*

"C" SHAFT.

C shaft is at present the principal producing shaft. As much as 2700 tons of ore have been hoisted at this shaft in 24 hours.

It is vertical, 9′x12′ inside, it is 580′ deep to the eighth level, it has two balanced cages and the hoisting is done by a pair of 30″x60″ Corliss engines, drums 14′6″x 10′6″x 5′.

Compressed air is used for power, but four 16′x60″ boilers are at disposal.

At the sixth level a shaft C′ raises ore from the seventh and eighth levels which is taken to "C" shaft by the wire rope haulage. A Rochester hoist, 12″x12″ with a 54″ drum, is placed at the sixth level hoisting a one-ton skip. The distance from A to B is 750 feet, from "B" to "C" 775 feet, and 1100 feet from C to D shafts.

The large and well-equipped timber shaft will attract the attention of the visitors. The duty of this shaft is to lower rock for filling, to supply all the timber for the mine, to lower men and may serve for raising ore in case of emergency. The shaft is in the foot-wall and is 8′x29′4″ inside of timbers. There are five compartments, four for hoisting and one for the balance-weights for the cages. An 18″x 24″ Corliss engine and 5′ drums serves for hoisting.

"D" SHAFT.

When sinking this shaft a water-bearing strata of quicksand was struck which made it impossible to continue the sinking of this shaft by any ordinary method. The work was accomplished at considerable expense by the freezing process of the Poetsch Freezing Company.

Twenty-six wrought iron pipes, 8″ in diameter, (closed at the lower end) were arranged in a circle of 29′ in diameter, and extending partly into the ledge of rock. Inside of this pipe a one and one-half inch pipe extended to within a few inches of the bottom. At the surface both pipes were connected to a Linde refrigerating machine, which maintained a circulation of saturated solution of chloride of calcium at a temperature of about zero, Fahr. A wall of frozen quicksand abount 13′ thick thus formed outside of the circle of pipes. Inside of the pipes the frozen quicksand had to be drilled and blasted just as if it were rock.

A detailed description of this freezing method and of all of the work done at this shaft with it will be found in the last year's volume of the School of Mines Quarterly, New York.

The shaft is in the foot-wall and extends to the fifth level at present, 230′ deep. The size of the shaft inside of the timbers is 15′6″x16′6″ and has four compartments, two for hoisting, one for pumps and one for air-pipes, ladders, etc. The hoisting will be done by a pair of 24″x60″ Corliss engines.

The substantial foundations for the large pumps to be placed at D shaft and the building for the engine will be seen in course of construction. The pumping will be done by a vertical compound condensing engine, cylinders

50″ AND 100″ BY 10′ STROKE.

The plungers for pumps will be 28″ in diameter and about 200′ apart. The plant will be operated by steam furnished by four Reynold's vertical tubular boilers, 18′x84″. It is the intention to run a water-way in the foot-wall at the eighth level to this shaft.

THE HYDRAULIC POWER PLANT.

The Hydraulic Power Company furnishes compressed air to the Chapin mine for motive power, nevertheless there is ample boiler capacity present to run the entire plant by steam in case any accident should happen to the hydraulic plant.

The air compressors are situated at Quinnesec Falls, on the Menominee river, about three miles from the mine. The falls furnish a natural head of water of about 52 feet, a deflecting wing-dam turns the water into a flume, from which the water is led to the turbines through iron penstocks 7 feet in diameter. The turbines are all of the same type and consist of three independent vertical 48-inch inward-flow turbines, and one 54-inch turbine. The plates appended show an elevation of the compressor plant, a plan and a view of the air pipe where it passes through the forest. The wood on both sides was chopped to avoid damages from fires.

The compressors were built by the Rand Drill Company, and consist of three pair of 32-inch diameter and 60-inch stroke and one pair of 36-inch diameter and 60-inch stroke. The cylinders and heads are water-jacketted and the pistons are hollow for a circulation of water.

The number of revolutions per minute is about 30 and the average air pressure 60 lbs., the pressure at the mine being from 2 to 3 lbs. less.

The main from the hydraulic works to the mine is a ¼″ rivetted wrought iron pipe about 3 miles long and 24 inches in diameter and has expansion joints every 480′. The plant furnished during 1889 2,544,022 cubic feet of air at 60 lbs., 60 degrees F., per day, representing about 1,700 horse power developed at the falls. The available horse power of the falls is estimated at about 6,000.

The compressed air serves at present the motive power for the entire plant and for 105 power drills.

This compressor plant is believed to be the largest one in the world.

CHEMICAL COMPOSITION.

The following analysis is a fair representation of the entire out-put of the Chapin ore from 1881 to 1889 inclusive, according to the chemist of the company, Mr. E. E. Brewster.

CHAPIN ORE:

Sesquioxide of iron	88.16
Alumina	1.08
Oxide of manganese	0.37
Potoxide of iron	0.51
Lime	0.81
Magnesia	2.71
Potash	0.07
Soda	0.05
Silica	4.20
Phosphoric acid	0.16
Sulphur	0.001
Volatile and organic matter	1.90
	100.02
Metallic iron	62.13 per cent.
Phosphorus	0.068 per cent.

CRESCENT ORE.

Sesquioxide of iron	92.21
Alumina	0.67
Oxide of manganese	0.21
Lime	0.50
Magnesia	1.64
Silica	3.35
Phosphoric acid	0.10
Volatile and organic matter	1.22
	99.90
Iron	64.55
Phosphorus	0.044

The ore is easily reduced in the blast furnace and is in great favor with all furnace men.

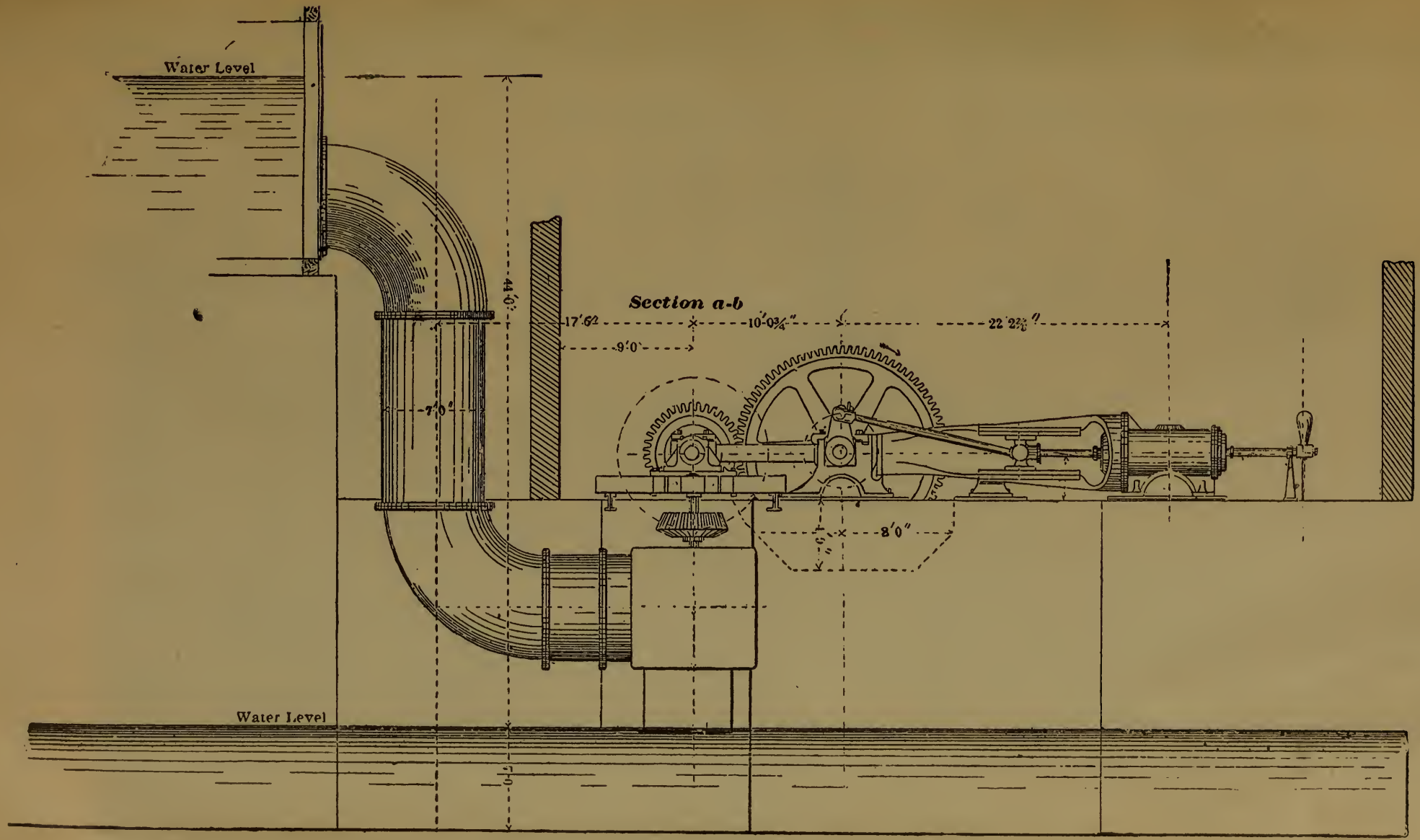
The number of men employed at the Chapin varies from 1800 to nearly 2000.

It is the intention to build out the stock-piles in such a form during the coming winter that the full benefit of a steam-shovel can be derived in the loading of cars upon the opening of navigation.

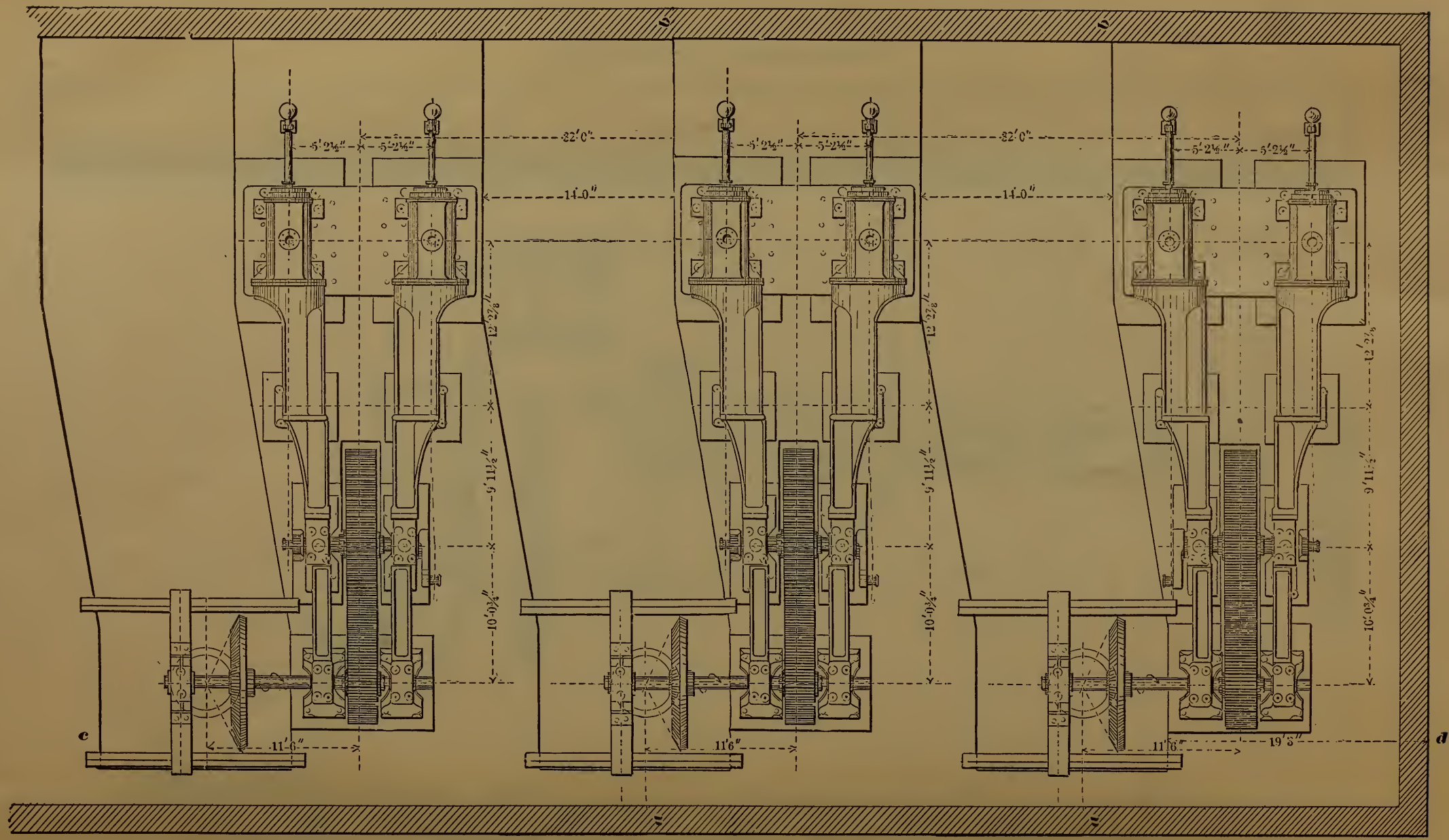
The steam-shovel was built by the Bucyrus Steam Shovel & Dredge Co. The capacity of the scoop is 2⅔ tons. The shovel is guaranteed to load 3000 tons in ten hours. The cost of loading cars by means of a steam-shovel is considerably lower than when done in the ordinary way.

A twenty ton ore car can easily be loaded in four minutes. The new ore cars all carry not less than twenty tons of ore, are equipped with automatic couplers, and the new Westinghouse Automatic Freight Brake with triple valve.

An excellent machine shop, blacksmith shop, saw mill, electric light plant and laboratory can also be seen.

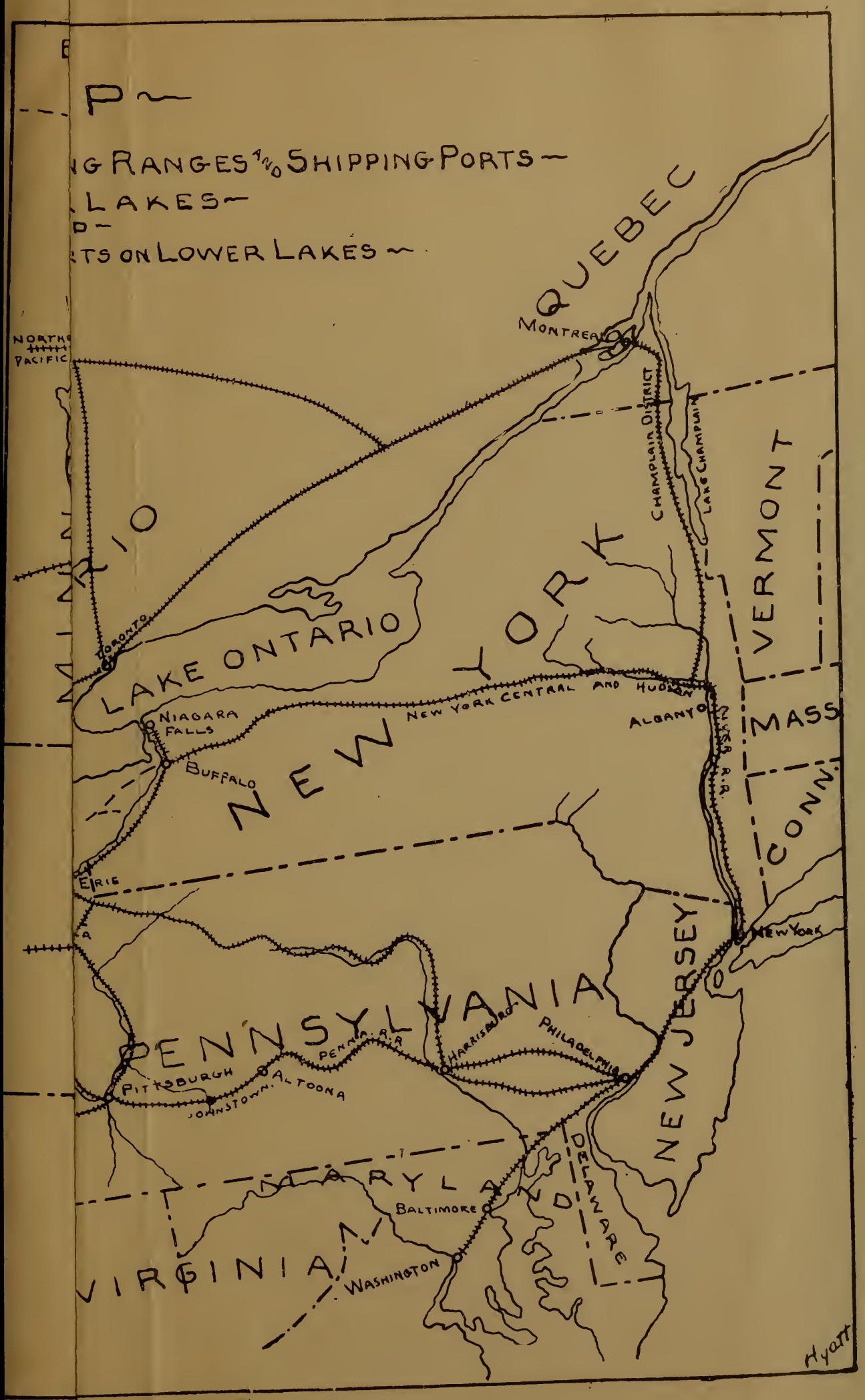


ELEVATION OF COMPRESSORS.



PLAN OF RAND COMPRESSORS, QUINNESEC FALLS, MICH.

LARGE PIPE OF HYDRAULIC POWER CO.

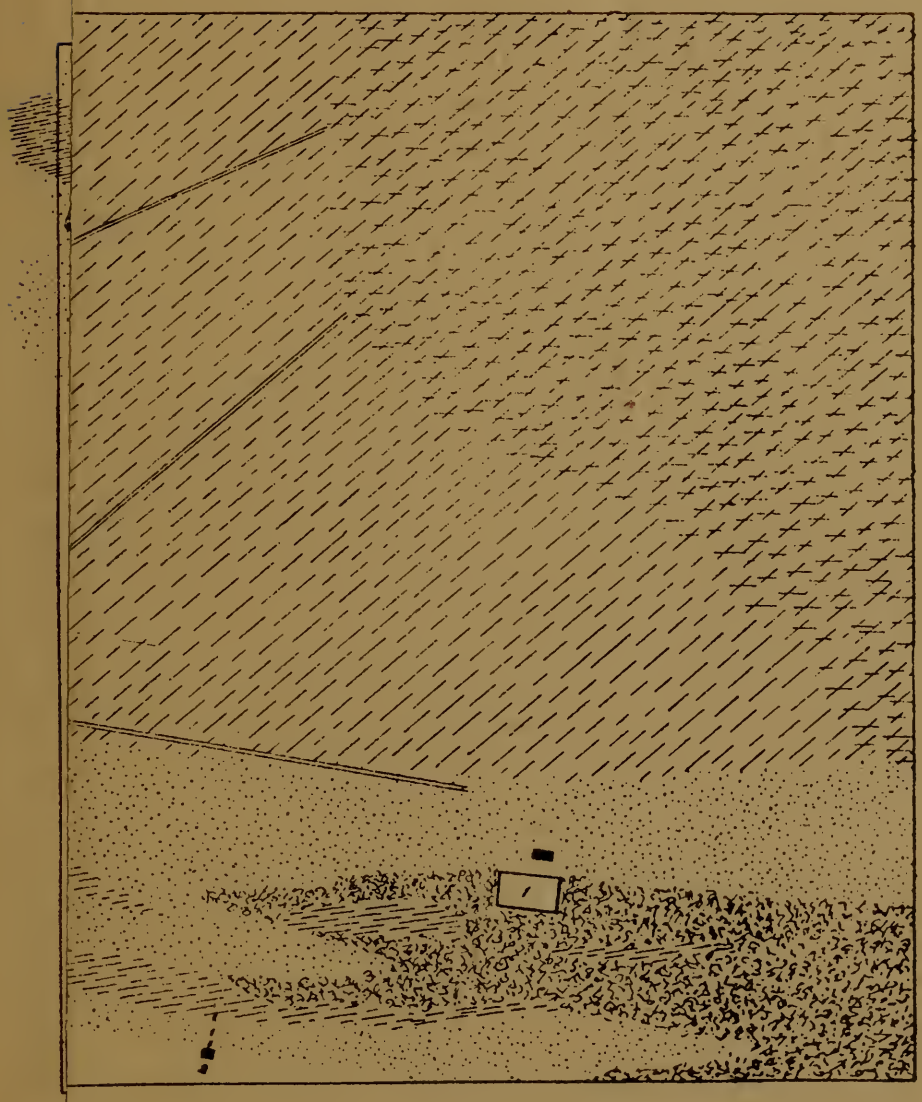

P~
NG RANGES AND SHIPPING PORTS~
LAKES~
D~
RTS ON LOWER LAKES~
QUEBEC
MONTREAL
NORTH PACIFIC
CHAMPLAIN DISTRICT
LAKE CHAMPLAIN
VERMONT
MASS
CONN.
TORONTO
LAKE ONTARIO
NEW YORK
NEW YORK CENTRAL AND HUDSON
NIAGARA FALLS
ALBANY
BUFFALO
ERIE
NEW YORK
NEW JERSEY
PENNSYLVANIA
PENNA. R.R.
HARRISBURG
PHILADELPHIA
PITTSBURGH
ALTOONA
JOHNSTOWN
BALTIMORE
DELAWARE
WASHINGTON
VIRGINIA
Hyatt

MAP

SHOWING ORE PRODUCING RANGES AND SHIPPING PORTS
ON UPPER LAKES
AND
RECEIVING PORTS ON LOWER LAKES

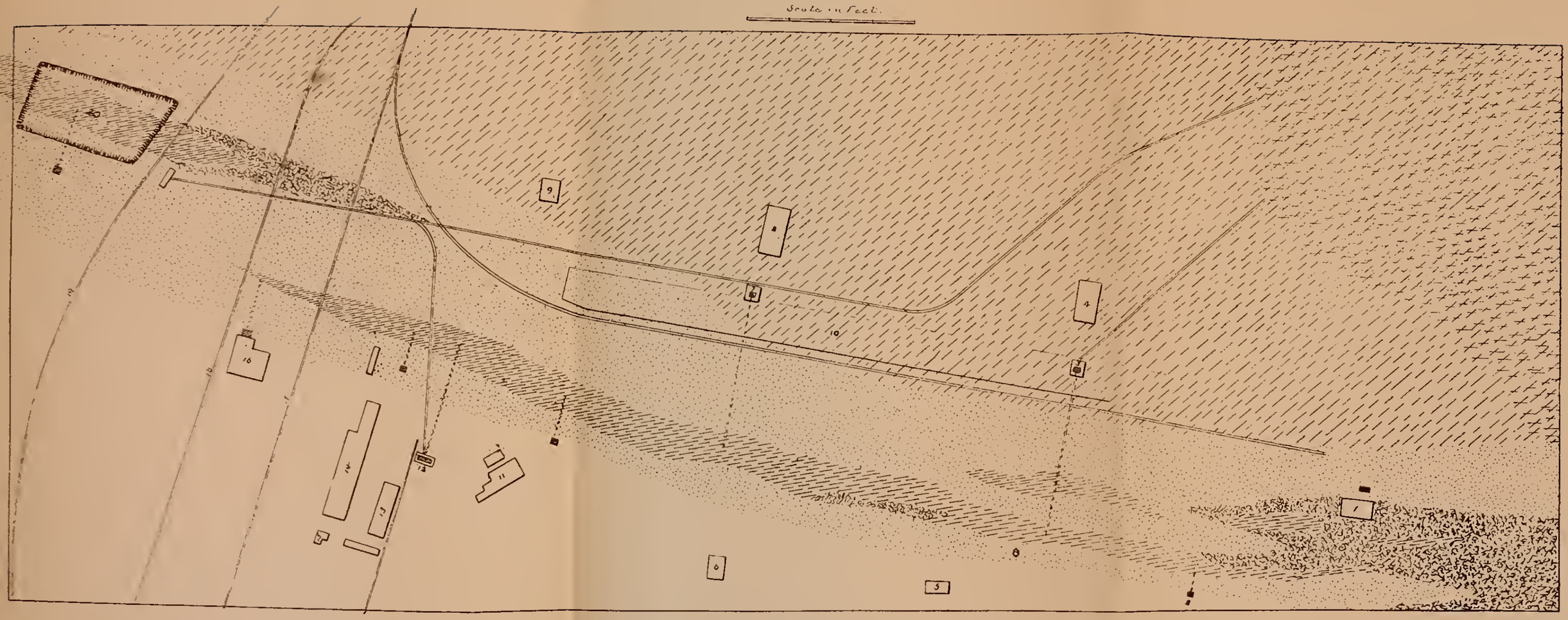
BRITISH AMERICA.
PORT ARTHUR
CANADIAN PACIFIC
ELY
TOWER
VERMILION DISTRICT.
LAKE SUPERIOR
COPPER DISTRICT
CALUMET
HOUGHTON
MARQUETTE
SAULT STE. M.
SUDBURY
QUEBEC
MONTREAL
TWO HARBORS
DULUTH
NORTHERN PACIFIC RR
SUPERIOR
ASHLAND
GOGEBIC DISTRICT
MARQUETTE DISTRICT
MENOMINEE DISTRICT
MENOMINEE
IRON MOUNTAIN (CHAMPION)
MINNESOTA
WISCONSIN
MICHIGAN
ST PAUL
LA CROSSE
MILWAUKEE
LAKE MICHIGAN
GRAND HAVEN
BAY CITY
ST IGNACE
LAKE HURON
ONTARIO
TORONTO
LAKE ONTARIO
NEW YORK
CHAMPLAIN DISTRICT
LAKE CHAMPLAIN
VERMONT
MASS
CONN
NIAGARA FALLS
BUFFALO
NEW YORK CENTRAL AND HUDSON R.R.
ALBANY
NEW YORK
DETROIT
LAKE ERIE
ERIE
ASHTABULA
TOLEDO
SANDUSKY
CLEVELAND
IOWA
ILLINOIS
CHICAGO
INDIANA
OHIO
PENNSYLVANIA
PENNSYLVANIA R.R.
HARRISBURG
PHILADELPHIA
NEW JERSEY
PITTSBURGH
JOHNSTOWN
ALTOONA
COLUMBUS
MARYLAND
DELAWARE
BALTIMORE
WASHINGTON
WEST VIRGINIA
INDIANAPOLIS
CINCINNATI
PORTSMOUTH
KY.
MISSOURI
ST. LOUIS
Hyatt

PLATE II.



Geological Map
of
CHAPIN MINE.

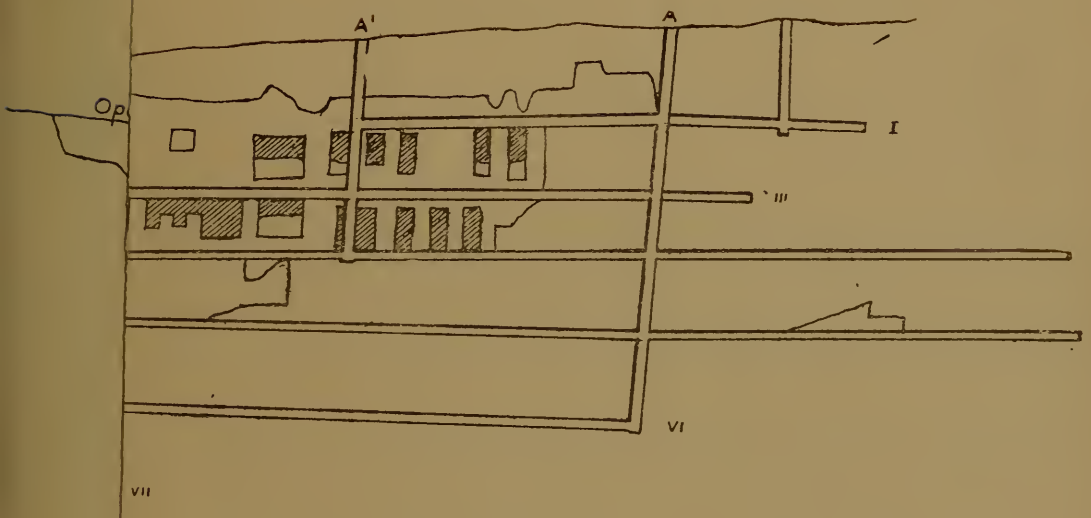
Scale in Feet.



1 A Pump House.
2 A' Shaft.
3 B Shaft.
4 Engine House.
5 Dry House.
6 5 Engine House.
7 C Shaft.
8 Engine House.
9 Office.
10 Stock Pile.
11 Saw Mill.
12 Timber Shaft.
13 Ware House.
14 Shops.
15 Laboratory.
16 D Pump Plant.
17 C & N W R R.
18 E J M. & M. R. R.
19 M. & N R R.
20 Open Pit

Dolomite. Sandstone. Slates Jasper. Ore.

PLATE III.


A'
A
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I
III
VI
VII

VERTICAL - LONGITUDINAL SECTION,

CHAPIN MINE.

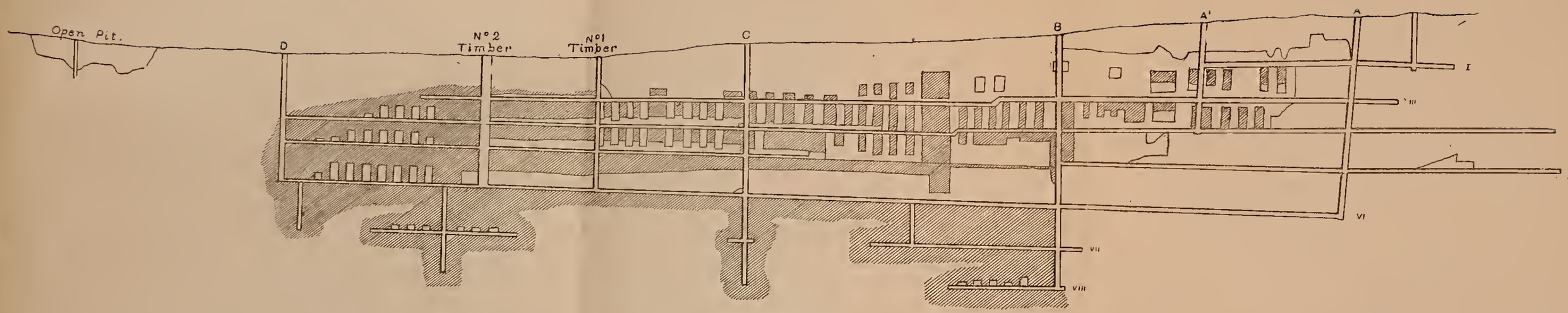

PLATE IV.

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 00074 6560